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THE GOVERNOR'S REPORT
THE POTENTIAL FOR DROUGHT
IN MONTANA FOR
1999

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The Honorable Governor Marc Racicot

Prepared by

Montana Drought Advisory Committee

April 1999

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SUMMARY

The Montana Drought Advisory Committee met February 22, 1999 to assess moisture and water supply conditions pursuant to MCA 2-15-3308. Generally, member agencies reported that the state's projected water supply and moisture conditions are average to above average. Currently, water supply forecasts call for above average streamflow runoff from mountain snowpack, both east and west of the Continental Divide, for spring of 1999. At this time, the likelihood of drought in Montana through the month of July is low.

The Drought Advisory Committee is charged with monitoring and assessing the state's water supply and moisture conditions, reporting its findings, and when appropriate, developing and implementing effective and timely responses to mitigate impacts of drought. Water supply and moisture conditions are summarized briefly below, and in more detail in the following section.

Mountain Snowpack

The Natural Resource Conservation Service (NRCS) reported that the snow water equivalent (SWE) of mountain snowpack is above average throughout the state. The SWEs of the upper Missouri and upper Yellowstone River basins are 13 percent above average. Snow water content of mountain snowpack west of the Continental Divide currently ranges from about 15 to 40 percent above the 30-year average for the period 1961 through 1990. Temperatures are expected to be average to below average for the month of April and could extend or prolong the period of runoff for the mountain snowpack.

Reservoir Storage

The U.S. Geological Survey April 2, 1999 *Report of March Streamflow and Reservoir Storage* reported that all five of the state's major hydroelectric production reservoirs had normal water storage levels at the end of March. The U.S. Bureau of Reclamation reported that, as of April 1, 1999, seven of nine water storage projects had contents within the normal range and two were slightly below average. Reclamation expects all of its projects will reach normal storage levels and as of March, no shortages were expected for the 1999 irrigation season. State-owned reservoir storage is near or above normal as of April 1.

Precipitation

Precipitation across Montana's plains and valleys has been well below average thus far in 1999, in contrast to the abundant precipitation received by the mountains of the state. The period of October 1998 through January 1999 brought above average precipitation to the entire state with the northeast division receiving nearly 300 percent of average and the southeast over 200 percent of average. But since February, valley precipitation has been below normal statewide. According to the NWS, many locations received less than 50 percent of the average monthly moisture for March.

Soil Moisture

Soil moisture across the state, by climate division, is currently rated as moderately wet in the southwest climate division, slightly wet in the northwest, southcentral, and northeast divisions, and near average in the northcentral, central, and southeast divisions. Recent precipitation has brought needed moisture to dry land farming regions of the state that experienced dry weather in the fall of 1998. However, windy winter conditions coupled with little or no snow cover on the prairie regions of the state has served to deplete soil moisture, especially in the topsoil layer.

Streamflow

The U.S. Geological Survey (USGS) reports that during March 1999, streamflow at five of eight long-term stream gauging stations had monthly mean streamflow in the normal range, two were above normal, and one was below normal. The NRCS *Montana Basin Outlook Report, April 1, 1999* reports that, across Montana, streamflow is forecasted to range between average and 20 percent above average for the period of April through July.

Climate

A La Niña climate anomaly developed during the fall of 1998. In keeping with past La Niña events, Montana received above average moisture, but only at high elevations. Many valley and plains stations have reported below average precipitation since the beginning of 1999. The cold temperatures expected to accompany the La Nina in Montana failed to materialize due to a strong jet stream that held cold air systems north of Montana for nearly the entire winter. As a consequence, freeze and drought damage to winter wheat was minimal. The unusually strong winds depleted topsoil moisture but wind damage to winter wheat was relatively low.

Conclusion

At this time, the probability of drought in Montana through July is low. The primary area of concern at this time is dry land agriculture due to low soil moisture in the parts of the north central, central, south central, and southeast climate divisions. The success of Montana's dryland farming production depends, ultimately, on adequate and timely precipitation.

Current long-range climate forecasts call for the current La Niña event to extend into summer, although levels of confidence for La Niña forecasts for Montana decrease as spring and summer approach. Although the state's water supply currently looks very favorable, timely precipitation through the spring and summer months will be necessary for dry land farming production, adequate streamflow, and low wildfire danger.

INTRODUCTION

The Montana Drought Response Plan defines drought as:

Drought is an extended period of below normal precipitation that causes damage to crops and other ground cover; diminishes natural streamflow; depletes soil and subsoil moisture; and because of these effects, causes social, environmental, and economic impacts to Montana.

In 1991, Montana's Fifty-second Legislature passed House Bill 537, creating a state drought advisory committee and defining its responsibilities. The law states:

By March 15th of each year, the Drought Advisory Committee shall submit a report to the governor describing the potential for drought in the coming year. If the potential for drought merits additional activity by the drought advisory committee, the report must also describe:

- (a) Activities to be taken by the drought advisory committee for informing the public about the potential for drought;*
- (b) A schedule for completing activities;*
- (c) Geographic areas for which the creation of local drought advisory committees will be suggested to local governments and citizens; and*
- (d) Requests for the use of any available state resources that may be necessary to prevent or minimize drought impacts (Section 2-15-3308 MCA 1991).*

LEGISLATIVE UPDATE 1999

The 1999 Montana Legislature passed HB 51, which was proposed by DNRC with support of the Montana Drought Advisory Committee. Governor Racicot signed the bill in February 1999. The legislation changes two provisions of the original statute:

First, the date for the required first meeting of the committee each year has been changed from mid-February to mid-March of each year.

Second, the *Governor's Report on the Potential for Drought* in the coming year, will now be released in mid-April, rather than mid-March as the original drought statute provided.

The change in the meeting date for the first meeting each year was proposed because the committee is more able to accurately assess conditions in March than in February for the coming water use and growing season. Furthermore, the evolution of the Internet has provided the committee, the media, and the public with immediate access to comprehensive and current water supply and moisture data.

The change of the *Governor's Report* release date from mid-March to mid-April coincides with the annual peak accumulation of the mountain snowpack, about mid-April of each year in Montana. The water supply outlook for spring through mid-summer becomes more clear at that time. The Montana Drought Response Plan will be better coordinated with the committee's first annual meeting date and the release of the *Governor's Report*. Finally, the committee can elect to meet earlier than the statute provides if conditions indicate a high potential for drought.

The Report

This report is divided into two sections. The first section, *Current Water Supply and Moisture Conditions*, includes current data on the state's water storage supply, soil moisture, mountain snowpack, streamflow, weather and climate forecasts, precipitation, and wildfire potential. The second section, *Responses to Water Supply and Moisture Conditions*, provides an assessment of the probability of drought in coming months given current conditions, and the Drought Advisory Committee's response to that assessment.

The Department of Natural Resources and Conservation (DNRC) prepares the Water Supply and Moisture Condition Report monthly, from February through October of each year. This report summarizes information on current and projected water supplies and soil moisture conditions collected by a variety of federal and state agencies. It is used by the Drought Advisory Committee (committee) to monitor water supply and moisture conditions as part of the state's drought management strategy. The *Governor's Report* serves as the report for the month of April, and includes the same data.

Included are data from the U.S. Geological Survey (USGS), National Weather Service (NWS), U.S. Bureau of Reclamation, Natural Resource Conservation Service (NRCS), DNRC, and the Montana Agricultural Statistics Service. The NRCS generates the Surface Water Supply Index (SWSI) for 52 Montana river basins. The Palmer Drought Severity Index (PDSI), which rates soil moisture, is provided by the NWS for the seven climate divisions of the state.

CURRENT WATER SUPPLY AND MOISTURE CONDITIONS

Surface Water Supply Index

The NRCS generates the Surface Water Supply Index (SWSI) as an index of surface water availability for 52 Montana river basins based on mountain snowpack, mountain precipitation, streamflow, soil moisture, and reservoir storage. The SWSI is used to forecast surface water supply, and is best applied to mountainous areas with surface water supplies that are primarily dependent on spring runoff of mountain snowpack (**Figure 1. *SWSI Values as of April 1, 1999***).

As of April 1, most of the state's river basins ranged from near *average to slightly wet*, with a few exceptions. The Tongue River basin ranked as *slightly dry* and the Yaak, Middle Fork Flathead, and the upper Yellowstone ranked as *moderately wet* (**Table 6. *Montana Surface Water Supply Indices, April 1, 1999***).

Mountain Snowpack

Most of the annual streamflow in Montana originates as snowfall that accumulates high in the mountains during fall, winter, and spring. As the snowpack accumulates, hydrologists estimate the runoff that will occur when it melts. Aquifers, lakes, streams, and reservoirs are largely dependent on runoff from mountain snowpack. Montana's mountain snowpack accumulates at a relatively constant rate from November through mid-April of each year. Mountain snowpack generally accounts for 80 percent of streamflow in spring and early summer in western Montana.

The NRCS Snow Survey maintains a network of automated remote gauging stations, known as SNOTEL, throughout the mountainous regions of the state. The stations in this system record snow water equivalent (SWE), total precipitation, and temperature and transmit the data daily, via telemetry to a central data collection facility. NRCS and National Weather Service hydrologists formulate monthly streamflow forecasts for the coming spring and summer, which are summarized monthly in NRCS Montana Basin Outlook Reports.

The NRCS "water year" for data collection and record-keeping commences on October 1 of each year and ends September 30 of the following calendar year. The current data-base used by NRCS covers the period of record 1961-90.

According to the NRCS *Montana Basin Outlook Report April 1, 1999*, the SWE of the mountain snowpack, statewide ranged from 83 percent of average in the Powder River basin to 139 percent of average in the Kootenai River basin. Almost all major river basins in Montana currently have mountain snowpack SWEs above average for this time of year, with the exception of the Powder, Tongue, and Milk river basins, which are slightly below average.

As of April 12, the Missouri River headwaters were 113 percent of average, with the Jefferson River basin at 110, the Madison at 117, and the Gallatin at 106 percent of average. The upper Yellowstone is 113 percent of average. West of the Continental Divide, the Kootenai River basin has the greatest amount of snow water remaining at 141 percent of average and the lowest water content of the five major basins was the upper Clark Fork River basin at 115 percent of average (see **Table 1. Remaining Montana Snowpack and Year-to-Date Precipitation**).

Reservoir Storage

Storage in the major reservoirs across the state was 94 percent of average and 80 percent of levels recorded last year at this time, according to the NRCS *April 1, 1999 Basin Outlook Report*. West of the Continental Divide, reservoir storage was 89 percent of average and 72 percent of April 1, 1998 levels. East of the divide, storage was 92 percent of average and 90 percent of storage at the same time last year. Reservoir operators have recently released stored water in anticipation of above average runoff of the mountain snowpack. No water shortages are anticipated at Reclamation reservoirs for the coming irrigation season (**Table 3. U.S. Bureau of Reclamation Reservoirs**).

State-owned reservoir storage levels currently range from about 75 to 130 percent of normal (**Table 4. *Status of State-Owned Reservoirs, April 1, 1999***). In some cases, storage contents were somewhat less than levels reported at this time last year. Some state-owned water projects with less storage than at this time in 1998, are being maintained at low levels to accommodate the anticipated spring runoff of the mountain snowpack. No shortages are expected at state-owned reservoirs.

Streamflow

The U.S. Geological Survey (USGS) operates and monitors numerous stream-gauging stations across the State of Montana. Eight long-term stream gauging stations are reported in **Table 2. *March 1999 Streamflow in Montana***. For the month of March, average monthly streamflow was normal at five stations, above normal at two stations, and below normal at one of the eight long-term streamflow-monitoring stations reported. Comprehensive and accurate streamflow monitoring begins in May of each year, after rivers are clear of ice.

According to the April 2, 1999 USGS *Report of March Streamflow and Reservoir Storage*, the mean March flow for the Yaak River near Troy was 117 percent of the 1966-95 average. Streamflow of the Clark Fork River at St. Regis and the Middle Fork of the Flathead River near West Glacier were 113 and 108 percent of average, respectively, for the month of March. East of the Continental Divide, the Yellowstone River at Billings was 83 percent of average. Average March streamflow for the Marias River near Shelby was 51 percent of average, and the Yellowstone River at Corwin Springs was 126 percent of average.

According to the NRCS *April 1, 1999 Montana Basin Outlook Report*, streamflows statewide are forecasted to range from average to above average for the period of April through July. Streamflow west of the Continental Divide is forecasted to range between 104 and 122 percent of average. The upper Clark Fork River basin will range from 96 to 125 percent of average for the period of April through July, the Bitterroot River will range from 111 to 129 percent, the Flathead River from 104 to 118 percent, and the Kootenai River from 112 to 129 percent of the 30-year average. East of the Continental Divide, streamflow for the same period is forecasted to be 96 to 129 percent of average for the Missouri River, and 90 to 112 percent of average for the Yellowstone River.

Soil Moisture

As of April 11, 1999, the Montana Agricultural Statistics Service reported that topsoil moisture across the state was rated as 4 percent surplus, 59 percent adequate, 30 percent short, and 10 percent very short. Subsoil moisture was rated at 3 percent surplus, 60 percent adequate, 27 percent short, and 10 percent very short. Poor prices and low fall moisture caused Montana winter wheat producers to seed the smallest crop since 1937. Table 5 lists the Palmer Drought Severity Index values for April 17, 1999, by climate division.

Precipitation

The National Weather Service reported that for the period October 1, 1998 through March 31, 1999, precipitation statewide ranged from average to above average. The following table summarizes precipitation, as recorded at valley locations for this period:

Precipitation Statewide, October 1, 1998 - April 15, 1999
Percent of Average (Preliminary)
National Weather Service

Division	10/1/98 – 3/31/99	3/1/99 – 3/31/99	4/1/99 – 4/15/99
Western	100	52	40
Southwest	101	63	71
Northcentral	114	52	42
Central	94	49	71
Southcentral	90	36	59
Northeast	233	34	125
Southeast	161	31	187

The National Weather Service reports that precipitation for the period April 1-15 was below average for most of Montana, with the exception of the northeast and southeast divisions. In the northeast, Glasgow received .82 of an inch of precipitation; in the southeast, Ekalaka received 1.73 inches and Miles City 1.06 inches of moisture; in the northcentral division, Malta received .84 inch of precipitation; in the central division Roundup received .59 inch; in the southwest Butte .59 inch and Dillon .48 inch; and in the southcentral division, Billings received .72 inch and Hardin .58 inch of moisture. Parts of the northwest division, including Kalispell and Superior, have received about one-half of an inch of precipitation in April. Missoula and Helena remain very low at less than one-tenth of an inch for April. Great Falls and Helena have less than 50 percent of normal moisture thus far in 1999.

According to the NRCS *April 1, 1999 Montana Basin Outlook Report*, mountain and valley precipitation for the period of October 1998 through March 1999 was 108 percent of average and 122 percent of last year east of the Continental Divide, and 116 percent of average and 145 percent of last year west of the divide. March mountain and valley precipitation was 77 percent of average west of the divide and 59 percent of average east of the divide.

According to the *Montana Climate Atlas* (Caprio and Nielsen, 1992), mountain precipitation west of the Continental Divide decreases in April but increases greatly east of the Continental Divide. The major increase shifts from the southern plains to the central and eastern plains as moisture from the Gulf of Mexico and Pacific Coast penetrates northward. In April, wet snow or rain typically leaves more than an inch of precipitation across the southern tier of the state. Storms in late April and early May can deposit a half-inch or more of precipitation in the northeast region. According to Caprio and Nielsen, "*Drought years are notably linked with the failure of these early season storms.*" Mountains along the divide in the far north and south of the state normally receive more than six inches of precipitation in April.

The Palmer Drought Severity Index

The Palmer Drought Severity Index (PDSI) indicates the long-term effects of precipitation shortfalls to soil moisture in rangeland, dryland crop areas, and timberlands. The PDSI values for April 17, 1999 indicate that drought conditions are not present in Montana at this time. The National Weather Service's Climate Analysis Center provides a composite Palmer value for each of the seven climate divisions of the state. Values currently range from +2.07 (*moderately wet*) for the southwest division, to -0.40 (*near normal*) for the southeast division. It should be noted that the use of one composite Palmer value for each geographic division can fail to identify local "pockets" of low soil moisture. The committee relies on local information and precipitation figures to identify areas of low soil moisture. The PDSI is based on measured precipitation, estimated evaporation and plant transpiration, and local climatic characteristics (**Table 5. *Palmer Drought Severity Indices in Montana***).

Weather and Climate Forecasts

Montana's last two winters have been somewhat unusual. The 1997-98 winter was dominated by the strongest El Nino episode in 50 years. El Nino winters are quite predictable in Montana; in almost every case, temperatures average above normal and precipitation averages below normal, both at the lower levels and in the mountains. That certainly was the case during the 1997-98 winter.

By the summer of 1998, El Nino's counterpart, La Nina, began to take hold in the Pacific Ocean. La Nina episodes are marked by colder than normal ocean surface temperatures near the equator, extending across the Pacific. Delving into the historical effects of La Nina on Montana's winter weather we found that, *on average*, the period of December through February was generally colder than normal, especially east of the Continental Divide (divide) and snowier than normal, especially west of the divide. However, past history also revealed that there were wide variations in the Montana winters during La Nina episodes. Some winters were warmer than normal and some less snowy than normal. So our confidence with regard to the 1998-99 winter was much lower than if we had an El Nino episode in progress.

As it turned out, portions of Montana experienced a typical La Nina winter, while other areas did not. West of the divide, many high elevation areas received precipitation as much as 20 to 40 percent above normal. That's typical during a La Nina winter. East of the divide, precipitation averaged near or below normal, but temperatures averaged well above normal. That is not typical.

What happened? The jet stream, which steers the storms, set up in a west to east flow across the northern Pacific Ocean, entering the Pacific Northwest along the coast, and proceeding inland across Montana. This jet stream was very persistent and consistent during most of December through February. As a result, moisture-laden Pacific storms were steered by the jet stream over Oregon, Washington, and Northern Idaho into western Montana, where most of this moisture dropped as snow in the higher mountains.

East of the divide in Montana, at least within the first 100 to 200 miles east of the Rockies, this persistent jet stream promoted rather strong winds and very little precipitation. So, not only was it dry, but the strong winds evaporated what little moisture there was. The eastern one-third of the state received quite a bit of moisture during the fall and normal or above normal amounts of snowfall during the winter months. However, as with the other areas east of the divide, temperatures during the winter months averaged well above normal, with very few intrusions of cold arctic air. Again, this was due to the persistent west to east jet stream. In order to get the very cold arctic air into Montana, the jet stream needs to “buckle,” such that a strong northerly branch steers the cold air down from the arctic region.

The National Weather Service’s Climate Prediction Center April 15, 1999, 30-day outlook for May calls for temperatures and precipitation to be in the normal range. The 90-day outlook calls for temperatures to be in the normal range across Montana and precipitation to be slightly below normal for the eastern one-third of the state. The six to ten-day forecast for the period April 27 through May 1 calls for average precipitation and slightly above average temperatures.

Most La Ninas diminish by early spring. The current La Nina is still strong and it is forecast to remain moderately strong for the next three to six months. Since 1950, there have been only three La Nina episodes that extended into early summer. During those three episodes, the western two-thirds of Montana received less than normal precipitation from May through early July and the eastern one-third of the state was about normal. This not a prediction but an indication of what happened in the past during similar La Nina regimes.

Wildfire Potential

As of April 12, 1999, DNRC and the Northern Rockies Fire Coordination Center predict fire severity potential for the Northern Rockies to be “normal” for the period of April through May 5, 1999. The mountain snowpack is above normal in most river basins, with the exception of the valley floors and lower to mid-elevations, which helps to hold down wildfire potential in the forested mountain areas through the spring and early summer. The center expects to continue to see a few fires in the early season but few, if any, problems are anticipated.

The long-range forecast predicts above normal temperatures for the western part of the region which could increase the potential for grass fires prior to “green-up” in May and June. The Northern Rockies region is providing some support for the fire activity in the southeast U.S. and expects this activity to increase due to the drought conditions that prevail in the southeast and southwest. Otherwise, DNRC and the Forest Service are currently engaged in normal pre-season preparation for the summer months.

RESPONSES TO WATER SUPPLY AND MOISTURE CONDITIONS

The potential for drought in 1999, although low at this time, warrants continued monitoring and reporting by the Montana Drought Advisory Committee through the spring and summer months. The committee heard updates regarding water supply and moisture conditions at the April 16 meeting and the next meeting date has been set for June 22, 1999. The committee will continue to monitor and report conditions over the next two months, assessing the potential for drought. If indications of drought are present, a meeting may be scheduled before the June 22 meeting. If appropriate, the committee will take action consistent with the Montana Drought Response Plan.

Response

The drought plan's initial level of response, *Drought Alert*, is not triggered before April 15 of a given year and must be triggered by SWSI values of -2.5 or less, and/or PDSI values of -3.0 or less. The *Severe Drought* level of response is not activated before May 15 and must be accompanied by SWSI values of -3.5 or less, and/or PDSI values of -4.0 or less. Currently, the lowest SWSI value in Montana is -1.2, or *slightly dry*. The lowest PDSI value in Montana at this time is +0.24 in the southeast division, or *near average*. The plan also mandates a close examination of other sources of data to confirm the status indicated by the PDSI and SWSI. Presently, neither the *Drought Alert* nor the *Severe Drought* level is warranted.

Monitoring and Reporting

Early season drought management focuses on monitoring water supply and soil moisture conditions and reporting to the media to keep the public apprised of the potential for drought. The committee will most likely meet one or two times before August, given the variability of Montana's climate and potential for rapid changes in moisture conditions. Typically, at least some areas of the state will experience economic impact from below average precipitation before the summer ends. Federal and state agencies that monitor water supply and moisture conditions will continue reporting through the committee and media on a regular basis. Updated information will be placed on Internet pages listed below on a regular basis.

Each month, the drought monitoring data and SWSI water supply map are entered on the Internet on the Natural Resource Information System (NRIS) Home Page. Links are provided to real-time snowpack, reservoir, and streamflow data. A number of climate data links provide La Niña updates and status reports. The National Drought Mitigation Center has many useful links to agricultural Internet sites. The drought committee staff can be contacted at (406) 444-6628. The NRIS Internet address is: <http://nris.state.mt.us/>. Go to the water information area and then to water supply and drought. The SWSI Map can be found under *1999 Data*.

The Montana Department of Agriculture Internet address: <http://agr.state.mt.us/>

Montana Agricultural Statistics Service Internet address: <http://www.nass.usda.gov/>

Montana DNRC Internet address: <http://www.dnrc.state.mt.us/>

TABLES

TABLE 1 Remaining Montana Snowpack and Year-to-Date Precipitation⁽¹⁾ Based on Mountain Data from NRCS SNOTEL Sites As of Monday, April 12, 1999		
River Basin	Remaining Snow Water Equivalents ⁽²⁾ (% of average) ⁽³⁾	Year-to-Date ⁽⁴⁾ Precipitation (% of average)
Kootenai River	141	119
Flathead River	118	105
Upper Clark Fork	115	106
Bitterroot River	126	116
Lower Clark Fork	132	115
Jefferson River	110	102
Madison River	117	105
Gallatin River	106	92
Missouri Headwaters	113	101
Headwaters Missouri Mainstem	110	90
Smith, Judith, & Musselshell Rivers	99	92
Sun, Teton, & Marias Rivers	120	101
Missouri Mainstem	110	96
St. Mary and Milk Rivers	119	104
Upper Yellowstone	113	105
Bighorn River (Wyoming)	115	123
Tongue River (Wyoming)	98	98
Powder River (Wyoming)	100	122
Lower Yellowstone	109	115

Notes

(1) Information provided by Natural Resource Conservation Service, Snow Survey.

(2) A "snow water equivalent" is the depth of snow equivalent to one inch of water.

(3) Reference period for average conditions is 1961-90

(4) October 1, 1998 to present.

TABLE 2			
March 1999 Streamflow in Montana ⁽¹⁾			
Station Name	Monthly ⁽²⁾ Mean flow (cfs)	1966-95 Average Monthly February flow (cfs)	% of average flow
Yaak River near Troy	726	620	117
Blackfoot River near Bonner	942	832	113
Clark Fork River at St. Regis	5,180	4,580	113
Middle Fork of Flathead near West Glacier	1,050	973	108
Marias River near Shelby	328	649	51
Rock Creek below Horse Creek, nr Int'l Bndry	374	74.8	500
Yellowstone River at Corwin Springs	1,180	939	126
Yellowstone River at Billings	2,630	3,150	83

Notes

(1) Information is provided by the U.S. Geological Survey (USGS). According to the USGS, the eight gauging sites in Table 1 are representative of streamflow conditions throughout Montana.

(2) Data is provisional and subject to revision.

TABLE 3⁽¹⁾**U.S. Bureau of Reclamation Reservoirs**

Reservoir	Drainage	4/1/99		Year Ago (4/1/98)	
		Contents ⁽²⁾ (ac-ft)	% of Avg.	Contents (ac-ft)	% of Avg.
Clark Canyon	Beaverhead	156,400	103	179,700	118
Canyon Ferry	Missouri	1,447,000	100	1,644,800	109
Gibson	Sun River	45,600	95	49,100	98
Lake Elwell	Marias River	704,500	102	774,800	110
Shrerburne	St. Mary & Milk Rivers	20,900	84	25,800	104
Fresno	Milk River	50,700	82	55,600	90
Nelson	Milk River	57,700	105	64,600	118
Bighorn Lake	Bighorn River	798,600	96	876,400	105
Hungry Horse	South Fork Flathead River	1,946,000	102	2,324,000	122

Notes

(1) Information from U.S. Bureau of Reclamation (USBR).

(2) "Content" refers to active contents only (dead storage not included).

TABLE 4

Status of State-Owned Reservoirs¹
April 1, 1999

Reservoir	Drainage	April 1, 1999			Year Ago (4/1/98)	
		Contents (ac-ft) ⁽²⁾	% of Avg.	% of Capacity	Storage (ac-ft)	% of Average
Missouri River Basin						
Ackley Lake	Judith River	3,530	99	61	4,480	126
Bair	Musselshell	4,290	74	61	5,030	87
Deadman's Basin	Musselshell	61,040	112	85	22,540	41
Martinsdale	Musselshell	11,420	92	49	17,940	145
Middle Creek (Hyalite)	Gallatin	6,880	145	68	7,900	166
Nilan	Sun River	6,980	103	69	10,050	148
North Fork of Smith	Smith River	8,870	97	77	9,800	107
Ruby River	Ruby River	32,910	91	85	30,740	85
Yellowstone River Basin						
Cooney	Rock Creek	16,880	87	59	22,540	116
Tongue River	Tongue River	12,290	34	16	9,510	26
Clark Fork River Basin						
East Fork Rock Creek	Rock Creek	12,960	128	81	14,820	146
Nevada Lake	Blackfoot	10,040	99	79	10,130	99
Painted Rocks	Bitterroot	11,600	58	37	3,380	17

Notes

- (1) Information from Montana Department of Natural Resources and Conservation, State Water Projects Bureau.

Ac-ft is an abbreviation for acre-feet, a measure of volume. An acre-foot covers one acre of land one foot deep.

TABLE 5.				
Palmer Drought Severity Indices (PDSI) in Montana⁽¹⁾				
District	PDSI 03/27/99	PDSI 04/17/99	Cumulative Precip. Deficit (inches)	
			03/27/99	04/10/99
Northwest	+2.62	+1.69	0.00	0.00
Southwest	+1.46	+2.07	0.00	0.00
Northcentral	+0.64	+0.35	0.00	0.00
Central	+0.14	+0.34	0.00	0.00
Southcentral	+0.52	+1.66	0.00	0.00
Northeast	+1.42	+1.12	0.00	0.00
Southeast	-1.28	- 0.40	0.80	0.00

Explanation: The Palmer Drought Severity Index describes the intensity of prolonged wet or dry periods as shown below.

Range	Description
+4.0 and greater	Extremely moist spell
+3.0 through +3.99	Very moist spell
+2.0 through +2.99	Unusually moist spell
+1.0 through +1.99	Moist spell
+0.5 through +0.99	Incipient moist spell
-0.49 through +0.49	Normal
-0.5 through -0.99	Incipient Drought
-1.0 through -1.99	Mild drought
-2.0 through -2.99	Moderate drought
-3.0 through -3.99	Severe drought
-4.0 and less	Extreme drought

Notes

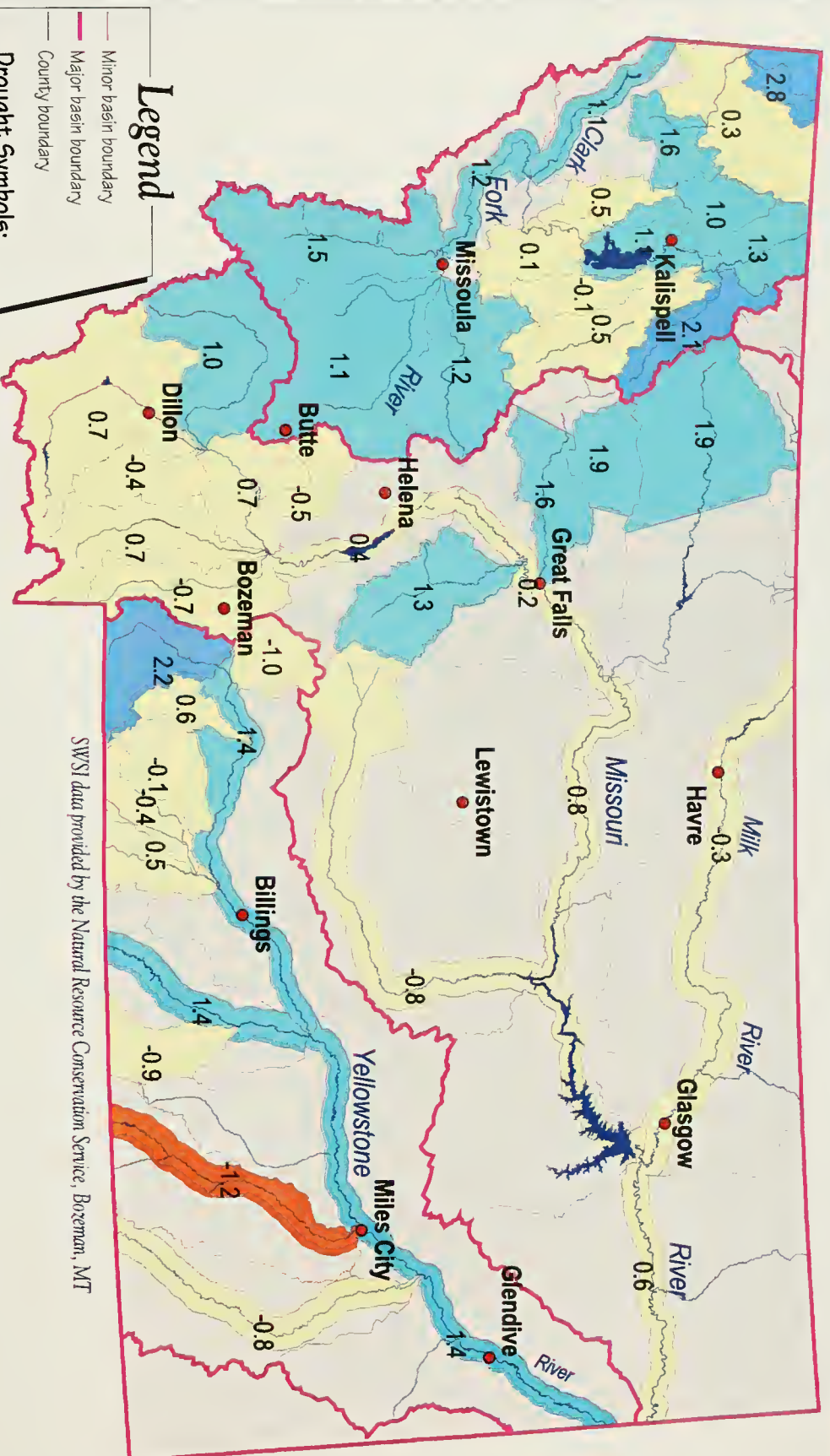
- (1) Palmer Drought Severity Indices provided by Climate Analysis Center, Wash., D.C.

Table 6.

**Montana Surface Water Supply Indices (SWSI's)
April 1, 1999**

Basin	SWSI	Basin	SWSI
Tobacco River	+1.3	Gallatin River	-0.7
Kootenai River below Libby Dam	+0.3	Missouri River above Canyon Ferry	+0.4
Fisher River	+1.6	Missouri River below Canyon Ferry	+0.2
Yaak River	+2.8	Smith River	+1.3
North Fork Flathead River	+1.3	Sun River	+1.6
Middle Fork Flathead River	+2.1	Teton River	+1.9
South Fork Flathead River	+0.5	Birch/Dupuyer Creeks	+1.5
Flathead River at Columbia Falls	+1.2	Marias River	+1.9
Stillwater/Whitefish Rivers	+1.0	Musselshell River	-0.8
Swan River	-0.1	Missouri above Fort Peck Reservoir	+0.8
Flathead River at Polson	+1.1	Missouri River below Fort Peck	+0.6
Mission Valley	+0.1	Milk River	-0.3
Little Bitterroot River	+0.5	Yellowstone River above Livingston	+2.2
Blackfoot River	+1.2	Shields River	-1.0
Clark Fork River above Missoula	+1.1	Boulder River (Yellowstone)	+0.6
Bitterroot River	+1.5	Stillwater River	-0.1
Clark Fork River below Bitterroot River	+1.2	Rock/Red Lodge Creeks	-0.4
Clark Fork River below Flathead River	+1.1	Clarks Fork Yellowstone River	+0.5
Beaverhead River	+0.7	Yellowstone above Bighorn River	+1.4
Ruby River	-0.4	Bighorn River	+1.4
Big Hole River	+1.0	Little Bighorn River	-0.9
Boulder River (Jefferson Basin)	-0.5	Yellowstone R. below Bighorn River	+1.4
Jefferson River	+0.7	Tongue River	-1.2
Madison River	+0.7	Powder River	-0.8

Note: The Surface Water Supply Index (SWSI) is an indicator describing predicted surface water availability. The April 1, 1999 SWSI describes surface water supply conditions near the start of the 1999 growing season. SWSI values are further illustrated on the Map Figure following this table.



Surface Water Supply Index (SWSI) Values: April 1, 1999

NOTE: SWSI values primarily indicate water supply conditions for irrigated lands within each basin. The SWSI index includes reservoir, streamflow, precipitation, and soil moisture data. The values shown may be based on provisional data and subject to change.



